

RETROFIT OF AVEDØRE POWER STATION – UNIT 1 (DENMARK)

BEST PRACTICE FACT SHEET

KEY INFORMATION

Plant owner:	Ørsted (called Dong Energy until 2017)
Plant name:	Avedøre Power Station
Location:	Copenhagen, Denmark
Industry sector:	Fossil firing power
Main product of plant:	Electricity and heat
Retrofit measure:	Change from coal to biomass combustion and lifetime extension of unit 1
Beginning of retrofit:	2015
Start-up after retrofit:	2016
Capital Expenditure including lifetime extension:	740 Million DKK (approx. 100 Million EUR)



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TECHNICAL DATA

Electricity production capacity [MW]

Heat production capacity [MW]

Main fuel

Estimated annual GHG emissions
[tCO₂eq]

Estimated annual specific GHG emissions
[gCO₂eq/kWh_{electricity}]

INITIAL STATE

250

350

Coal

Not available

Not available

AFTER RETROFIT

258

370

Pellets

Not available

Not available

INITIAL STATE

The Avedøre Power Station started operation in 1990, when the western part of the Greater Copenhagen area got its own CHP plant. The station consists of two units (Unit 1 and Unit 2 incl. two gas-turbines) with a total maximum capacity of 801 MW of electricity and 915 MW of heat. Avedøre Unit 1 was commissioned in 1990 as a 250 MW unit fueled with coal and oil. Unit 2 was built in 2001 as a multi-fuel plant that enables a fuel-flexible operation on either natural gas, oil, or wood pellets. At Unit 2, an additional biomass boiler operating on straw (firing up to 25 tonnes of straw per hour) is connected to the main boiler steam cycle.

“The decision to convert Unit 1 means that Avedøre Power Station abandons coal entirely when generating heat for more than 215,000 households in the Greater Copenhagen area.”

RETROFIT

MOTIVATION AND DECISION

In 2015, Avedøre Unit 2 was able to run entirely on biomass (pellet and straw), whereas Unit 1 had gradually depleted its lifespan. Therefore it was decided to retrofit the plant by means of a bio-conversion and lifetime extension. In March 2015 an agreement was signed between VEKS (district heating provider for the western part of Copenhagen) and DONG Energy (today Ørsted, owner of Avedøre power station). The agreement stated that from 2016 until 2033, Avedøre Unit 1 would supply green heat to VEKS' customers. The agreement was the basis of the investment to retrofit Unit 1 and prolong its lifetime.

PLANNING AND EXECUTION

The conversion of Unit 1, financed by Ørsted and VEKS, was initiated in April 2015 and completed in December 2016. To maintain fuel flexibility, the plant is still able to burn coal, but wood pellets are its primary fuel. The retrofit included an upgrade of the existing conveyor belt system whereas the existing storage facilities and cranes could be reused. Four-day silos were modified to coal/wood pellets silos with cross-feed system (i.e. 2 with coal and 2 with wood pellets). Each silo can feed two mills with either wood pellets or coal. Boilers were also retrofitted in order to adapt to pellet combustion. Existing coal mills were adapted to pellets, burners were modified and primary air coolers were installed.

1990

AVEDØRE
UNIT 1 STARTS
OPERATION

2015

AGREEMENT
ON RETROFIT
AND LIFETIME
EXTENSION

2015

START OF
RETROFIT

2016

UNIT 1 STARTS
OPERATION
BASED ON
BIOMASS

2023

PHASE OUT
OF COAL

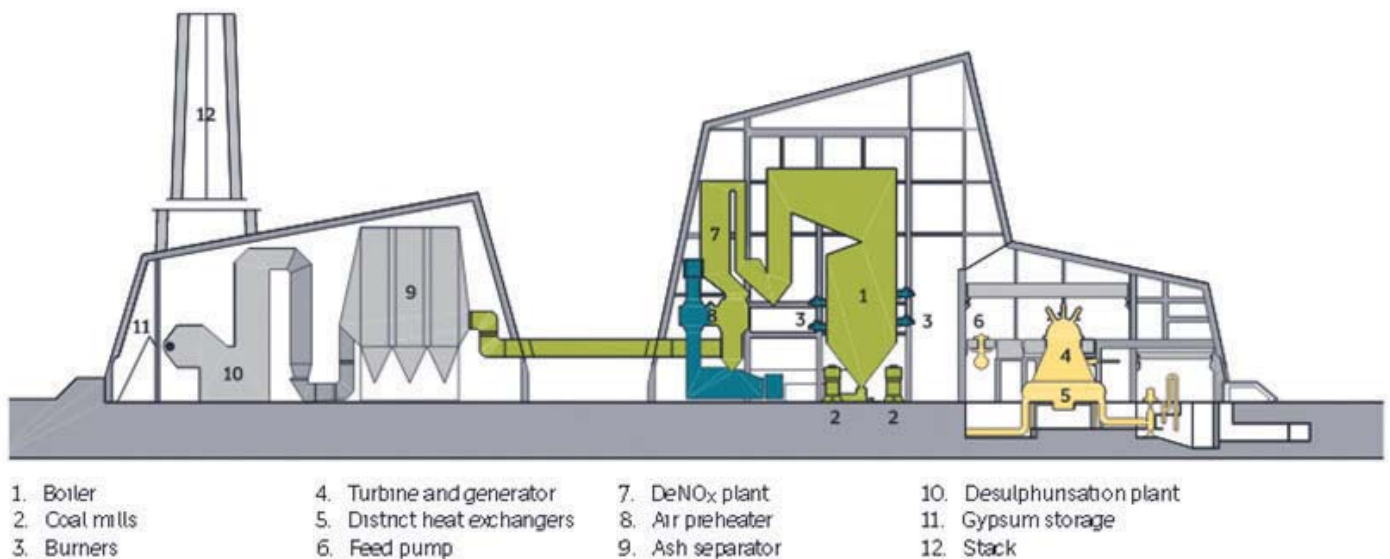
CURRENT STATE

Avedøre Unit 1 processes about 350,000 tonnes of biomass per year. The unit's capacity is 258 MW electricity and 370 MW thermal. By using the excess heat from the power production for district heating, Unit 1 attains an energy conversion efficiency of up to 91%. The annual amount of energy actually produced at Avedøre Power Station depends on weather conditions (which impact the demand) and fuel prices (which impact supply economics).

Wood pellets arrive at Avedøre Power Station by ship mainly from the Baltic countries. Before being blown into the boiler as dust (at a rate of about 38 kg/second), wood pellets are crushed in roller mills. An air cooler ensures that the crushed wood pellets do not ignite before reaching the boiler.

The flue gas treatment includes the collection of bottom ash, (which is later reused as fertiliser and insulation material) as well as the removal of nitrogen oxides (NO_x), fly ash, (reused in cement and concrete), sulphur dioxide (SO_x) and heavy metals.

By 2023 the unit will no longer use coal as Ørsted has made a strategic decision to phase out coal completely.



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IMPACT

Thanks to the retrofit of Unit 1, the Avedøre Power Station (Unit 1 and Unit 2) produces district heating based on biomass for approximately 215,000 households and electricity corresponding to the annual consumption of more than 600,000 households. This is a significant contribution to the Danish capital's ambition of being CO₂ neutral in 2025.

“The company Ørsted, owner of the Avedøre Power Station, committed to stop all use of coal in their plants by 2023. From 2006 to 2019 Ørsted has reduced its coal demand by 81%, therefore it is already well on the way to phasing out coal”

SOURCES

<https://greycellsenergy.com/examples/avedore-power-station-biomass/>

<https://ramboll.com/projects/re/biomass-conversion-and-lifetime-extension-of-avedore-unit-1>

<http://biomassmagazine.com/articles/11737/dong-energy-to-convert-final-unit-at-avedore-plant-to-biomass>

<https://stateofgreen.com/files/download/5194> <http://edepot.wur.nl/444861> <https://orsted.com>

MORE INFORMATION ABOUT THE AVEDØRE POWER STATION

Website <https://orsted.com>

Contact info@orsted.com



THE BIOFIT PROJECT

This best practice factsheet was prepared within the BioFIT project. The project aims to facilitate the introduction of bioenergy retrofitting in Europe's industry. Target industries are

- First-generation biofuels
- Fossil firing power
- Pulp and paper
- Combined Heat and Power (CHP)
- Fossil refineries

Success factors of the best practice case studies are used as basis to develop **10 concrete bioenergy retrofitting proposals** (2 per industry sector) and to facilitate the two-way dialogue with industry in dedicated working groups. The overall target is to integrate bioenergy and biofuels in existing industrial installations and encourage others to follow the existing examples.

Project website <https://www.biofit-h2020.eu> Contact reumerman@btgworld.com

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